A measure of partisan advantage in redistricting

Jon X. Eguia[*]

Michigan State University

February 7, 2019

--WORK IN PROGRESS—

The latest version is available at https://msu.edu/~eguia/measure.pdf

Abstract

I propose a measure of partisan advantage in redistricting. Redistricting is the process of drawing electoral district maps. Electoral outcomes depend on the maps drawn. The measure I propose is to compare the fraction of seats won by each party, to the fraction of counties, weighed by population, won by this party. If a party has a larger fraction of seats than the fraction of citizens living in counties in which the party won most votes, then the drawing of the electoral maps conferred an artificial advantage to this party. This measure takes into account the geographic sorting of partisan voters, it is simple to compute, and judicial courts can use it to declare any redistricting map that confers an excessive advantage to one party to be in violation of state or federal constitutions. Using data from the 2016 and 2018 elections to the US House of Representatives, I show that redistricting maps in North Carolina, Ohio, Georgia, Nebraska and Utah confer an excessive artificial partisan advantage to Republicans, and maps in Maryland and Arizona to Democrats. Maps in all these states should be redrawn.

1. SUMMARY

In March 2019, the US Supreme Court will hear cases challenging the redistricting maps in North Carolina and Maryland. At stake is whether a party in control of a state assembly can draw electoral district maps that help the party win more seats with fewer votes, or whether districts must be drawn in such a way that does not confer an advantage to any party.

As far back as 1986, the Supreme Court determined that maps that confer too great an advantage to any party constitute a partisan gerrymander and must be replaced by fairer maps. The problem is that the Supreme Court needs "an easily administrable standard"[1] to determine which maps are a partisan gerrymander, and so far, the Supreme Court has not found any standard to its liking.

Concepts such as vote-to-seat curves or the "efficiency gap"[2] can measure partisan advantage, but they cannot address a key question: can some (or all?) of the partisan advantage be innocently explained by the geographic sorting of voters? Indeed, for any map with compact districts, a party with many of its voters concentrated in a small area will obtain fewer seats than another party whose voters are better dispersed over most of the state.

I propose a notion of partisan advantage that accounts for this natural advantage due to population sorting, and measures only the artificial partisan advantage caused specifically by the chosen redistricting map.

The proposed measure of artificial partisan advantage consists on comparing the seats that a party obtains, to the seats that the party would obtain if seats were assigned in proportion to the population in counties in which the party won most votes.

County lines are fixed, not subject to redistricting. The measure of artificial partisan advantage credits each party for the population of any county in which it wins. This accounts for the sorting advantage: a party with a sorting advantage will win more counties, and hence it will earn more seats according to this measure. Seats won in the election in excess to those that would accrue according to county lines are evidence of an artificial partisan advantage derived from the drawing of favorable redistricting maps.

I suggest the following threshold rule: if the artificial partisan advantage is the greater than 10% of the state's delegation, the map is presumed to be a partisan gerrymander.

The North Carolina and Maryland congressional maps pending before the Supreme Court are both partisan gerrymanders according to this rule. In fact, using data from the 2016 and 2018 elections to compute the measure for each of the 43 states in the US that must draw district maps for the US House of Representatives, I find that North Carolina's map is the worst partisan gerrymander drawn by a Republican legislature, and Maryland is the worst partisan gerrymander drawn by a Democratic legislature. Both of these maps confer an excessive artificial partisan advantage, and on the basis of this evidence, they should both be struck down.

---

[1] Justice Kennedy's opinion in *Vieth vs Jubelirer* 541 U.S. 267 (2004).
[2] Stephanopoulos and McGhee (2015).

Five other states also have maps with an excessive artificial partisan advantage: Nebraska, Utah, Ohio and Georgia in favor of Republicans, and Arizona in favor of Democrats. In the aggregate over all 43 states, the Republican Party obtained a net artificial partisan advantage equivalent to 15 seats in the House of Representatives both in 2016 and in 2018.

In Section 2 below, I discuss the problem of measuring partisan gerrymandering, the most relevant court cases on this issue, and the virtues and limitations of existing measures. In Section 3 I detail my proposed measure of artificial partisan advantage, and in Section 4 I compute it for each state in the US.

2. THE PROBLEM

In some democracies, representatives to a legislative assembly are elected by drawing electoral districts and letting each district elect a single legislator to represent the district.[3] In order to preserve an equal population across districts, the boundaries of these districts must change with population changes. Redistricting is the process of drawing maps that partition a given polity (a country, a state, etc.) into electoral districts.

In the United States, redistricting typically occurs every ten years, following a decennial population census. Because electoral outcomes depend on how the redistricting maps are drawn, those in charge of redistricting have incentives to draw maps that advance their own electoral goals. The practice of manipulating the drawing of the district maps to favor one party of class is called "gerrymandering." The Voting Rights Act of 1965 made it illegal to gerrymander on racial grounds in such a way that dilutes the vote of a racial minority, and subsequent decisions by the Supreme Court of the United States (henceforth, "SCOTUS") have also limited the practice of drawing maps that artificially pack minority voters together.[4]

Recently, attention has shifted to partisan gerrymanders: while drawing maps with the intention and effect of reducing the representation of voters of any given race is illegal, is it permissible to draw maps to reduce the representation of Democratic or Republican voters?

In *Davis vs Bandemer* 478 U.S. 109 (1986), SCOTUS held that claims that a redistricting map is a political gerrymandering are justiciable; that is, the courts can resolve these claims and can strike down maps that provide too much partisan advantage to one party. However, SCOTUS could not agree upon a test or measure of what constitutes an excessive partisan advantage to actually adjudicate such claims.

In *Vieth vs Jubelirer* 541 U.S. 267 (2004), a plurality opinion by Justice Scalia argued that there are no "*existing manageable standards for measuring […] a political gerrymander*", and hence that partisan gerrymandering is a political question that is not subject to judicial review. A minority of four justices disagreed, proposing various such standards. The decisive opinion by Justice Kennedy rejected all the proposed standards and agreed with the plurality opinion that an "*easily administrable standard*" did not exist, but it also crucially held that such a standard could be found in the future. Therefore, claims that a redistricting map is a partisan gerrymandering remained justiciable, pending the future development of an appropriate standard to adjudicate them.

In *League of United Latin American Citizens vs Perry* 548 U.S. 399 (2006), the majority opinion by Justice Kennedy again reaffirmed that the Courts can, in principle, determine whether a redistricting

---

[3] The United States uses this system, as does the United Kingdom, and several other countries with a legacy of British rule, such as India or Canada.

[4] *Shaw v. Reno*, 509 U.S. 630 (1993), *Miller v. Johnson*, 515 U.S. 900 (1995), *Bush v. Vera*, 517 U.S. 952 (1996).

map is an illegal partisan gerrymander, but in practice it once again failed to find the necessary but elusive "*reliable standard for identifying unconstitutional political gerrymanders.*"

In 2016, a redistricting map was finally struck down as a partisan gerrymander. In *Whitford v Gill*,[5] a 3-judge District Court for the first time accepted a definition of partisan bias: "the efficiency gap" (Stephanopoulos and McGee 2015), and used it to invalidate the Wisconsin state election maps. The efficiency gap counts the number of wasted votes cast for each party. Votes are regarded as wasted if they are cast for a losing candidate, or if they are cast for the winning candidate in excess of 50% of the vote share necessary to win. A party with many wasted votes is collecting votes inefficiently. If a map is such that one party collects votes much more efficiently than the other, there is an efficiency gap, and the map is presumed to be unconstitutional.

In *Common Cause vs Rucho* (2018),[6] another District Court panel invalidated the North Carolina congressional map, using two measures: the efficiency gap, and the distribution of outcomes over all possible computer-simulated maps, showing that the North Carolina map was an extreme outlier (Chen and Cottrell 2014).

Both *Whitford v Gill* and *Common Cause v Rucho* were appealed to SCOTUS, raising hopes among anti-gerrymandering activists that SCOTUS would follow the two district courts, and finally accept a standard, a measure, to adjudicate cases of partisan gerrymandering. Alas, on that occasion, it was not to be: In a unanimous opinion in June 2018, SCOTUS resolved *Gill v. Whitford*, 585 U.S. ___ (2018) by sidestepping the key substantive issues and remanding the case back to lower courts on technical issues about judicial standing. A week later, it also vacated and similarly remanded *Rucho v Common Cause* back to lower courts.

In consequence, 33 years after *Davis vs Bandemer,* we are still waiting to find a standard to identify partisan gerrymanders that is acceptable to SCOTUS.

Early attempts to define partisan bias estimated the number of seats that each party would get in a hypothetical election in which the two largest parties got 50% of the votes (Brookes 1959, 1960); or, generalizing this idea, compared the two parties' seats given other vote shares to construct each party's "vote-to-seats" curve, which depicts the number of seats the party would get for each vote share. For instance, if a given vote share between the two parties is exactly reversed, would the seat shares also be reversed? If not, this asymmetry is evidence of a partisan bias (Tufte 1973; Grofman 1983; and King and Browning 1987). However, SCOTUS has not been receptive to measures based on counterfactual vote shares: "*we are wary of adopting a constitutional standard that invalidates a map based on unfair results that would occur in a hypothetical state of affairs*" (Justice Kennedy's concurring opinion in *Vieth vs Jubelirer*).

The efficiency gap mentioned above, and the mean-median vote share test rely only on actual election results, and not on counterfactuals. The mean-median vote share test consists on comparing a party's median vote share across districts with its vote share across the whole state (McDonald 2015, Wang 2016). Redistricting doesn't change the mean, but it can create an asymmetry by elevating a favored party's median, allowing the party to obtain half the seats even if it obtains fewer than half the votes in the state. According to these criteria, a large asymmetry in the parties' number of wasted votes, or in their median-to-mean differences, is indicative of a partisan gerrymandering.

A problem with measuring partisan bias according to any asymmetry in electoral results across parties is that the asymmetry may very well have arisen naturally due to the sorting of the population

---

[5] *Whitford v. Gill* 218 F. Supp. 3d 837.
[6] *Common Cause v Rucho*, 279 F. Supp.3d 587.

into specific locations within the State. Consider, for instance, a hypothetical State consisting of three islands of equal population, named East I., North I. and South I, and assume this state must draw three districts. Suppose the Left party obtains 90% of the vote in the East Island, and 30% in the North and South islands. If the State each island constitutes its own district, the Left's median vote share across districts is 30%, while its mean is 50%; the right's median is 70% and its mean 50%, so the asymmetry in median-mean differences is huge. Similarly, the Left party wastes one third of all votes cast (1/3 times 40%+30%+30%), while the Right only wastes one sixth of all votes cast (1/6 times 10%+20%+20%), so the efficiency gap is one sixth.[7] The asymmetry in this case is not due to an artificial drawing of districts, but due to the sorting of voters across the three islands.[8]

SCOTUS is aware of this sorting effect: *"Consider, for example, a legislature that draws district lines with no objectives in mind except compactness and respect for the lines of political subdivisions. Under that system, political groups that tend to cluster (as is the case with Democratic voters in cities) would be systematically affected by what might be called a 'natural' packing effect."* (Justice Scalia's plurality opinion in *Vieth vs Jubelirer*). Perhaps for this reason, SCOTUS has not accepted asymmetry of outcomes as a standard to identify partisan gerrymanders: "*I would conclude asymmetry alone is not a reliable measure of unconstitutional partisanship*" (Justice Kennedy's concurring opinion in *Vieth vs Jubelirer*).

If we cannot use counterfactual vote shares, and we need something other than asymmetry in outcomes, one approach left is the one used in *Common Cause v Rucho*: take the given vote totals in each precinct, code a computer program to draw a large number of possible redistricting maps, simulate what the seat outcomes would be according to each of those maps, compute the distribution of such hypothetical seat shares, and then check where in the distribution is the real outcome with the actual map (Chen and Cottrell 2014). If it is at an extreme of the distribution, then the map is a partisan gerrymander. The US District Court that resolved *Common Cause v Rucho* found this approach compelling, and I do too, but in seeking standards that are "judicially discernible and manageable" (Justice Scalia's plurality opinion in *Vieth vs Jubelirer*) and "easily administrable" (Justice Kennedy's concurring opinion), SCOTUS appears to prefer simplicity, and to be apprehensive of sophisticated simulations generated by statistical experts. SCOTUS is set to revisit *Rucho v Common Cause* in 2019, and one wonders if it may sympathize with the appellant's critique of expert statistical analyses as "*a smorgasbord of alleged 'social science' theories.*"[9]

Perhaps when it considers the second appeal of *Rucho v Common Cause* in 2019, SCOTUS will finally recognize in the efficiency gap, or in distribution of outcomes over all possible simulated redistrict maps, the elusive measure of partisan gerrymandering that a majority of the Court has been striving for since 1986. However, in case SCOTUS is as unimpressed by these two new measures as it had been by previous ones, it would be good to present it with a new one that satisfies SCOTUS' explicitly stated criteria: i) a measure that is "*manageable*", "*discernable*" and "*easily administrable*" -by which I understand to mean one that is "simple"-; ii) a measure that does not rely on counterfactual vote shares nor on asymmetry of results; iii) a measure that distinguishes between a natural partisan advantage due to population sorting, from the artificial partisan advantage; and iv) one that provides a criterion to determine if a given redistricting map generates an excessive artificial partisan advantage.

In the next section, I suggest one such measure.

---

[7] This is over twice the 8% threshold recommended by Stephanopoulos and McGhee (2015).

[8] See Chambers, Miller and Sobel (2017) for a critique of the "efficiency gap", and Stephanoupoulos and McGhee (2018) for a rebuttal.

[9] District Court's Memorandum Opinion in *Common Cause v Rucho*, page 21.

3. A SOLUTION

Consider a state *S*, and an assembly *A* in which state *S* has a delegation of *k* seats. Consider a given redistricting map *m* that divides state *S* into *k* districts with approximately equal population. Consider a given voting profile *v*, which indicates how each citizen voted. For each party *p* that competes in state *S*, let $s_p(v,m)$ denote the number of seats that party *p* wins, given the voting profile *v* and the redistricting map *m*.

Given the voting profile *v*, if we can identify a benchmark number of seats $s_p(v)$ that party *p* should receive with "natural" maps, then we can define the **artificial partisan advantage** that map *m* gives to party *p* as

$$s_p(v,m)- s_p(v).$$

The crux in this approach is to identify a "natural" map that generates the benchmark number of seats a party should earn. The map I suggest is to use counties, weighing them by population, so that in each county, the party that received most votes earns a number of seats proportional to the population of the county.

Formally, for each county *c* in state *S*, let n_c denote the population of the county, and let *n* be the total population of the state. And for each party *p,* each district *d* and each county *c,* let $v_p(c,d)$ be total number of votes that party *p* obtains in the precincts of district *d* inside county *c.* Party *p* wins in county *c* if its sum of votes across all of county *c* is the greatest, that is, if $\sum_d v_p(c,d) > \sum_d v_{p'}(c,d)$ for any other party *p'*.[10]

Then we calculate the natural number of seats $s_p(v)$ by assigning $\frac{n_c}{n}k$ seats to party *p* for each county *c* in which party *p* won given the actual election results *v.* Note that this measure typically results in a fractional number of seats. For instance, if there are two seats to be assigned, and party *p* wins in counties that represent 62% of the population of the state, then $s_p(v)$ is 1.24 seats.

This procedure can be summarized by the following definition of artificial partisan advantage:

Definition: *The artificial partisan advantage conferred by a redistricting map to a given party is the difference between the seats the party obtains, and the seats that correspond to the party according to the total population of counties in which the party obtained the most votes.*

Why counties? For this, I turn to SCOTUS's own words. Justice Scalia's plurality opinion in *Vieth vs Jubelirer* described as "*natural*" the results that emanate from a map based on nothing other than compactness and "*the lines of political subdivisions.*" The exact quote is as follows:

"*Consider, for example, a legislature that draws district lines with no objectives in mind except compactness and respect for the lines of political subdivisions. Under that system, political groups that tend to cluster (as is the case with Democratic voters in cities) would be systematically affected by what might be called a 'natural' packing effect*" (Scalia plurality opinion in *Vieth v Jubelirer,* page 1783).

County lines cannot be used to draw the actual redistricting map, because counties do not have equal population. But counties are politically neutral, and can be used to create a benchmark, neutral seat outcome against which to compare the outcome obtained with a given map *m.*

The "natural" sorting effect that Scalia mentions will be incorporated into the calculation of the number of seats $s_p(v)$: political groups that tend to cluster will only win the counties in which their votes cluster, resulting in a low number of seats according to county lines, that is, a low $s_p(v)$. In contrast, a party *p* whose voters constitute a small majority over most counties -the Republican party fits this

---

[10] Ties are unlikely, and very rare. If two parties tie in a county, we count as if each party won half the county.

description in some states- will naturally earn most seats according to $s_p(v)$, even if v is such that the two main parties split the total vote share equally. Therefore, if a map m is such that party p earns even more seats than those deserved according to county lines, then we can safely conclude that this excess of seats $s_p(v,m)$- $s_p(v)$ is not due to the natural sorting of the population. Rather, it is an artificial partisan advantage created by map m.

For instance, in 2018, in the election to the US House of Representatives in North Carolina, the Republican party obtained 50.4% of the total votes cast across all thirteen US House races, and it obtained the most votes (i.e. it "won") in counties accounting for 51.1% of the population. So if p denotes the Republican Party in North Carolina, $s_p(v)$=13*(51.1%), which is equal to 6.64 seats. This is the benchmark number of seats that corresponded to the Republican Party, according to county lines. Since actual redistricting maps must round to integers, we then infer that with unbiased maps, the Republican party should have obtained 7 or 6 seats, or perhaps 8 or even 5 if we allow some small bias. Instead, the Republican party obtained 10 seats.[11] We can then compute an artificial partisan advantage of

$$s_p(v,m)\text{- }s_p(v) = 10 - 6.64 = 3.36 \text{ seats.}$$

I present the full computation for one state (New Hampshire) in Table 3 in the Appendix; all others are available from the authors.

I suggest using counties, and not local authorities such as municipalities for two reasons. First, for ease of computation: election results are reported by counties, not by municipalities, and so the data by county is publicly available and easily accessible to all. And second, with a few exceptions, counties are the political unit closest in size to the congressional districts that need to be drawn.[12]

Having computed the measure of artificial partisan advantage, we need to determine how much artificial advantage is too much. Since the benchmark seat allocation with county lines is fractional, and actual redistricting maps must result in seat outcomes that are integers, a deviation of up to 0.5 seats must be allowed, merely to account for the necessary rounding. The question is how much leeway to concede, in addition of this rounding margin of 0.5. Again following SCOTUS,[13] I suggest a threshold of 10% of the size of the state delegation, and hence the following rule.

***Artificial Partisan Advantage Rule*:** *A redistricting map is presumed to be a partisan gerrymander if it confers an artificial partisan advantage of more than the sum of 0.5 seats and 10% of the state delegation*

Violating this artificial partisan advantage 10% rule leads only to a presumption, and not to an infallible determination, because under unusual configurations of voters, it is possible that satisfying requirements such as compactness (Chambers and Miller 2010), or the Voting Rights Act necessarily leads to violating the rule. For instance, if a party p wins two counties worth half a seat each at opposite

---

[11] Results in Congressional District 9 were later disputed, under allegations of fraud, and have not been certified at the time of writing.

[12] Huge counties are an exception. Among these the ones with a nearly even partisan divide, and in particular Maricopa in Arizona, and Harris in Texas, create a problem of excessive lumpiness: these counties are the size of half a dozen congressional districts, and they hide a division between a more Democratic city the size of two (Phoenix in AZ) or three (Houston in TX) congressional districts, and a more Republican remainder worth another three districts. In results below, I treat these two counties exceptionally, by dividing them as if they were each made of two separate counties: Maricopa-Phoenix and Maricopa-Rest, Harris-Houston and Harris-Rest.

[13] In *Brown v. Thomson*, 462 U.S. 835 (1983), SCOTUS used 10% as the threshold of population differences across districts beyond which the difference is a *prima facie* evidence of discrimination. It used this threshold more recently in *Harris vs Arizona Independent Redistricting Commission* 578 US __ (2016). I suggest the same threshold be used for evaluating a redistricting plan.

ends of the state, and loses all precincts in between, then $s_p(v)$=1 but compact maps would be such that the party p wins no seats.

The threshold of 10% is somewhat arbitrary; its main appeal is that it finds precedent in previous SCOTUS decisions. Two maps, one just above and one just below the threshold are very similar. The suggestion is that the 10% rule on artificial partisan advantage be used only to determine presumption, so that if a map is above this threshold, the State defending it bears the burden of proving that such a large artificial advantage is necessary to satisfy other legitimate requirements; whereas, if a map is close to but below this threshold, it is up to those contesting the map to show that that other maps, more compact, more respectful of political boundaries, compliant with the Voting Rights Act and any other relevant legislation, and with a lower partisan advantage, were easier to draw, so that there was no justification for the high artificial partisan advantage in the challenged map.

4. RESULTS FROM 2016 and 2018 US CONGRESS ELECTIONS

To compute the artificial partisan advantage in the House of Representatives, I use population data from the 2010 US Census, and election data by county for the 2016 and 2018 US House of Representatives elections, obtained from Dave Leip's Election Atlas.[14]

In Table 2 in the Appendix I show the artificial partisan advantage in the 2016 election for each of the 43 states with at least two seats in the US House of Representatives. In Table 3 I show the results for the 2018 election. For convenience, for each state, these tables report: the size of each state's delegation; the fraction of the two-party vote obtained by the Republican Party; the total population in counties won by Republicans and Democrats; the benchmark number of seats that would accrue to the Republican party according to county lines; the number of seats that the Republican party actually won, and in the last column, the artificial partisan advantage as the difference between the preceding two columns (negative numbers correspond to Democratic artificial partisan advantage).

A first substantive finding is that in the aggregate across all states, the net Republican **aggregate artificial partisan advantage** is **fifteen seats**: in 2016, the GOP earned 50.7% of the nationwide two-party vote, and a ten million lead in the population of counties won across these 43 states. These results yield 221 seats in these states according to our benchmark with county maps, but the GOP obtained 236 seats in these states, plus five more in the one-seat states (AK, MT, ND, SD and WY). Instead of a deserved majority of seventeen (226-209), the GOP enjoyed a majority of forty-seven (241-194) in the House.

In 2018, the electoral fortunes turned, but the artificial partisan advantage remained constant. The GOP's share of the nationwide two-party vote shrunk to 45.8%. In the 43 states subject to redistricting, counties with a combined population of 28 million citizens flipped from the GOP to the Democratic party, so that according to our benchmark, the number of seats in these states earned by the Republican party decreased from 221 to 179, a decrease of 42. The number of seats actually obtained by the GOP in these states decreased by 42, but from 236 to 194 seats[15], leaving the Democratic party with a majority of thirty-six (235-199) instead of the majority of seventy-six (250-174) it would have enjoyed without the artificial partisan advantage, given how citizens voted in the 2018 election.

These aggregate patterns are indicative of the magnitude of the problem, but they are not proof of partisan gerrymandering: redistricting is conducted independently by each State, and in principle, we could obtain an aggregate artificial advantage for a party of 15 seats by having an advantage of less than 0.4 seats in each State, which is less than the rounding margin necessary to produce delegations without fractional seats. For evidence of partisan gerrymandering, we must look at each state independently.

---

[14] I am currently working on extending the analysis to the 2014 and 2012 elections.
[15] Not including the NC-9 seat, not certified due to allegations of fraud.

Aggregating across both elections, the encouraging finding is that half the states have neutral maps, with no evidence of any partisan gerrymandering. This group of states includes both those with conservative (Kansas, Kentucky, Mississippi, Oklahoma, Tennessee) and liberal majorities (Illinois, New Jersey, Oregon. Most others have a small artificial partisan advantage favoring the party that controlled the maps. A few exhibit a larger artificial partisan advantage. The worst offenders are: North Carolina, Nebraska, Utah, Ohio and Georgia in favor of Republicans; and Maryland and Arizona in favor of Democrats. These seven states are the only ones that violate the 10% rule for artificial partisan advantage.

I analyze each of these, and other states that hold special interest either because their maps have been challenged in Court or because they are the largest in the Union (or both): California, Illinois, Michigan, New York, Pennsylvania, Texas, Virginia and Wisconsin. It is noteworthy that each party's worst gerrymander (North Carolina for the Republicans and Maryland for the Democrats) are back at SCOTUS in 2019. I provide evidence to support the claim that SCOTUS should strike down both of them.

I present the evidence by state in order from the greatest to the least evidence of partisan gerrymander.

4.1. North Carolina: a GOP partisan gerrymander.

North Carolina is on a class of its own, because it is the only state in which the map-drawers have explicitly acknowledged that the redistricting maps are, by design, a partisan gerrymander. In North Carolina, redistricting maps are drawn by the legislature, which throughout 2011-18 has been under Republican control. In *Cooper v Harris* 581 US __ (2017), SCOTUS struck down the 2011 map as a racial gerrymander, forcing the NC legislature to redraw them. According to Mark Lewis, chair of the NC General Assembly's redistricting committee, the redrawn maps are not a racial gerrymander, because their design is partisan, not racial; their intent is to elect as many Republicans as possible. In Lewis's words: "*I think electing Republicans is better than electing Democrats." "So I drew this map to help foster what I think is better for the country." "I propose that we draw the maps to give a partisan advantage to 10 Republicans and three Democrats because I do not believe it's possible to draw a map with 11 Republicans and two Democrats*."

These redrawn maps were challenged and found unconstitutional in the series of *Common Cause v Rucho* cases: a panel district court found these remedial maps unconstitutional in January 2018; in July 2018 SCOTUS vacated the January 2018 district court ruling and sent the case back to the district court for reconsideration, and in August 2018 the district panel reaffirmed its previous decision, once again declaring the remedial maps unconstitutional, and requiring a second set of remedial maps. SCOTUS decided in September 2018 to let the 2018 election be held under the challenged maps, and set to hear the case again during its Spring 2019 term.[16]

The North Carolina maps are as clear a case of partisan gerrymander as there can be, so they serve to test the efficacy of a measure: any measure of partisan gerrymandering ought to identify North Carolina's maps as such. The measure of artificial partisan advantage based on the county lines benchmark satisfies this minimum test.

North Carolina exhibits the greatest artificial partisan advantage of any state. The maps were drawn to attain a 10-3 Republican majority delegation, and they attain this outcome for any plausible election outcome. In 2016, the Republican Party obtained 53% of the two-party vote, and it won in counties with 5,121,000 citizens, or 53.7% of the total population, earning close to 7 of the 13 seats according to the natural benchmark. But it won 10 seats, as designed by the plans. In 2018, its vote share decreased to 51.0%, and the population in counties it won decreased to 51.1% of the state, earning 6.5 seats. And yet,

---

[16] See all the relevant judicial documents as of February 1st, 2019, on the Brennan Center website https://www.brennancenter.org/legal-work/common-cause-v-rucho.

on Election Day the Republican Party won 10 seats.[17] The artificial partisan advantage for the GOP, averaged over the two elections, is 3.2 seats, which, after discounting the 0.5 rounding margin, 2.7 is more than twice the 10% threshold on the size of the state delegation (13).

With these voting results, the NC delegation in the US House should be a Republican majority of 7-6. It is 10-3. This is a partisan gerrymander of about 3 seats.
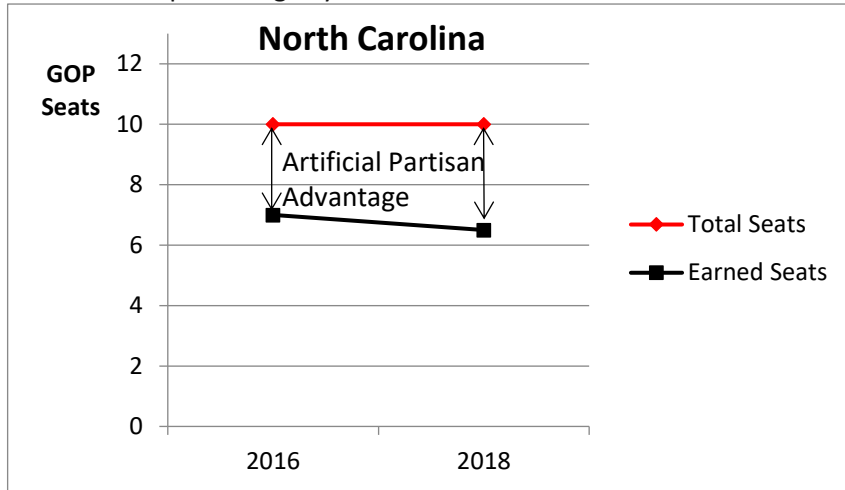
4.2. Nebraska: a GOP partisan gerrymander.

Nebraska's case is simpler. The state's legislature, under GOP control, draws the redistricting maps. The state has three seats in the US House. The Democratic Party wins in Douglas County, the largest county in the state, home of Omaha, and close to the size of a congressional district. In 2018, it also won Lancaster County, seat of the Lincoln campus of the University of Nebraska. Together, the two counties represent 44% of the state population, earning the Democratic Party a benchmark of 1.32 seats. But they get none. Averaging over the two elections, the artificial partisan advantage for the GOP is 1.1, discounting the rounding margin of 0.5, it becomes 0.6 seats, almost twice as much as the 10% threshold of a state delegation of 3 seats.
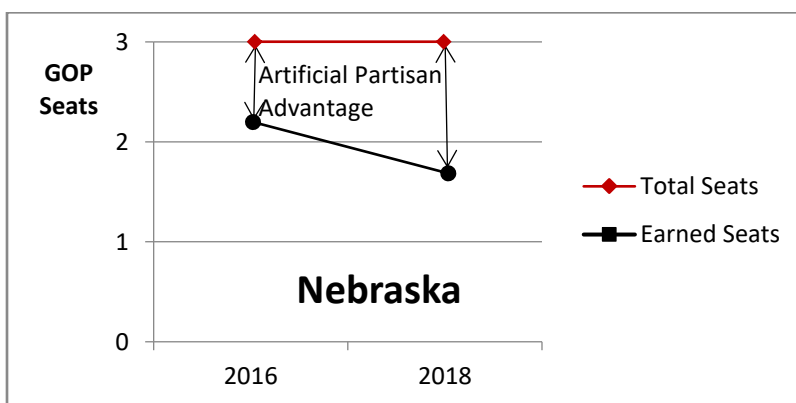
4.3. Utah: a GOP partisan gerrymander.

The case of Utah is similar to Nebraska. The size of the state delegation is four seats. The legislature draws districts. The Democrats win in Salt Lake County, the largest of the state, home to over a million citizens, and hence worth one and a half congressional districts by itself. Nevertheless, in 2016 the state delegation was a GOP 4-0 majority. In 2018, the Democrats did win one seat. The GOP's artificial

---

[17] Charges of fraud later put the NC-9 seat in question, as the result was not certified, nor the winner seated.

partisan advantage of 1.54 seats in 2016 and of 0.56 in 2018 averages to 1.05 seats over the two elections; discounting the rounding margin, to 0.55, or 13.7% the size of the state delegation, above the threshold.

On the other hand, Utah voters have approved a ballot initiative to create a commission with some powers to influence the redistricting process, so perhaps the redistricting maps after the 2020 census will lessen the GOP's artificial partisan advantage, even absent judicial intervention. With current voting patterns, the state delegation should have either 1 or 2 Democrats, as opposed to switching between 0 or 1 as it did with the 2011 maps.
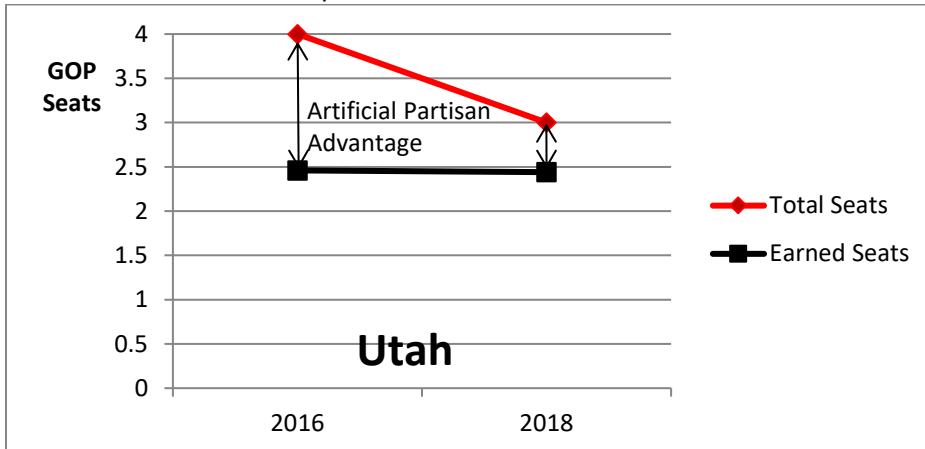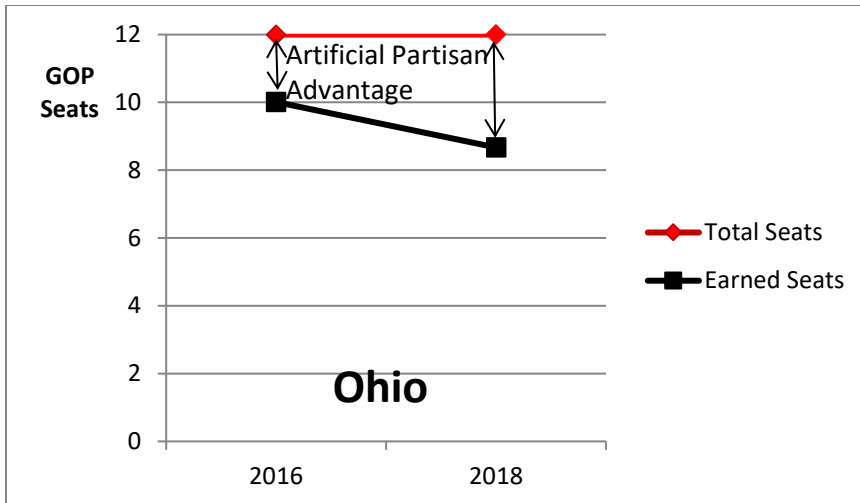

4.4. Ohio: a GOP partisan gerrymander.

In Ohio, the state legislature draws the redistricting maps. The state delegation has 16 seats. The legislature has been under GOP control in 2011. In May 2018, voters approved a ballot initiative to reform the redistricting process, and in response the legislature changed its redistricting rules, to encourage more bipartisan maps, and to make it more difficult –but not impossible- for a majority to draw a partisan gerrymander. Also in 2018, the League of Women Voters and the Phillips Randolph Institute filed charges, challenging the maps as a partisan gerrymander, in a case that will be heard as *Phillips Randolph Institute v Smith* in March 2019. The evidence on the artificial partisan advantage strongly favors the plaintiffs.

In 2016, the GOP obtained 58.2% of the two-party vote for US Congress in Ohio, winning in counties with 62.6% percent of the population, which corresponds to exactly 10 of the 16 seats. But according to the 2011 maps, the GOP obtained 12 seats. In 2018, the GOP vote share decreased to 52.4% and its collection of counties won shrunk as well, reducing the population in GOP counties to 54.2%, which corresponds to 8.7 seats. However, the boundaries of congressional districts were designed such that the 12-4 GOP majority was impervious to such changes in electoral conditions, and the GOP won three quarters of the congressional districts, despite winning little more than half the votes or the population-weighted counties.

Averaging across both elections, the artificial partisan advantage for the GOP in Ohio is 2.66 seats; discounting the rounding margin of 0.5, the excess is 2.16 seats, more than 10% of the state delegation, enough to presume that the maps, as alleged by the plaintiffs in *Phillips Randolph Institute v Smith,* is a partisan gerrymander.

In short, the GOP should have gotten 10 out of 16 seats in 2016, and 9 out of 16 in 2018; it got 12 in both, an artificial partisan advantage of 2 or 3 seats thanks to gerrymandering.

4.5. Arizona: a Citizens' Commission partisan gerrymander in favor of the Democratic Party.

In Arizona, an independent citizens' commission draws the redistricting map. Its delegation has nine seats. Its 2011 maps were perceived to favor the Democratic Party.[18] In November 2011, the Arizona Senate dismissed the commission's Chair, and soon after the Arizona Supreme Court reinstated it. The Arizona legislature filed suit to regain the power of redistricting, but lost in *Arizona State Legislature v. Arizona Independent Redistricting Commission, 576 U.S. ___ (2015).*

The perception that the Commission's 2011 maps favored Democrats appears warranted: from 2012 to 2018, on average the Republican Party has obtained more than 54% of the two-party vote, for less than 46% for the Democratic Party, and yet both parties have alternated equally between four and five seats.

The extraordinary large size of Maricopa County, where almost 60% of all Arizona citizens reside, creates complications in computing the artificial partisan advantage. With a population of over 3,817,000 citizens, Maricopa is worth approximately five and a half congressional districts. Maricopa is competitive: it went Republican in 2016 and Democrat in 2018. Looking at Maricopa as a whole hides a stark division within it between Phoenix, which is the size of more than two congressional districts and where the Democratic Party won handily in 2018, and the non-Phoenix rest of Maricopa, the size of more than three districts and solidly Republican. Assigning all five and half seats of Maricopa to the party that wins it all would distort the reality that any drawing of districts must split Maricopa into multiple districts, some of which would be Democratic, some others Republican. I therefore split Maricopa into two units that I treat as separate counties: Phoenix, and the Non-Phoenix part of Maricopa.[19]

In 2016, the Democratic Party won in counties with 24% of the population, and didn't win any of the two parts of Maricopa (so the splitting was moot), earning a benchmark of 2.16 seats, and it obtained 4. In 2018, the Democratic Party won in Phoenix, and the total population in counties it won plus Phoenix was 41.9%, earning a benchmark of 3.77 seats. It won 5 seats. Averaging across both elections, the artificial partisan advantage is 1.53, which, discounting the rounding margin of 0.5, is 1.03, more than 10% of the state delegation.

---

[18] "Redistricting draft map in Arizona favors Democrats," by Aaron Blake, Washington Post, Oct. 4, 2011.

[19] More generally, any county large enough that it contains within it a clearly defined subarea worth several congressional districts, and such the majority party in this subarea is the opposite as the majority party in the county, should be split into smaller units. I only found two such counties: Maricopa in Arizona, and Harris in Texas. I split them by treating the largest city in the county as an independent unit.

In short, the Commission's maps allowed the Democratic Party to win an extra seat in each election.
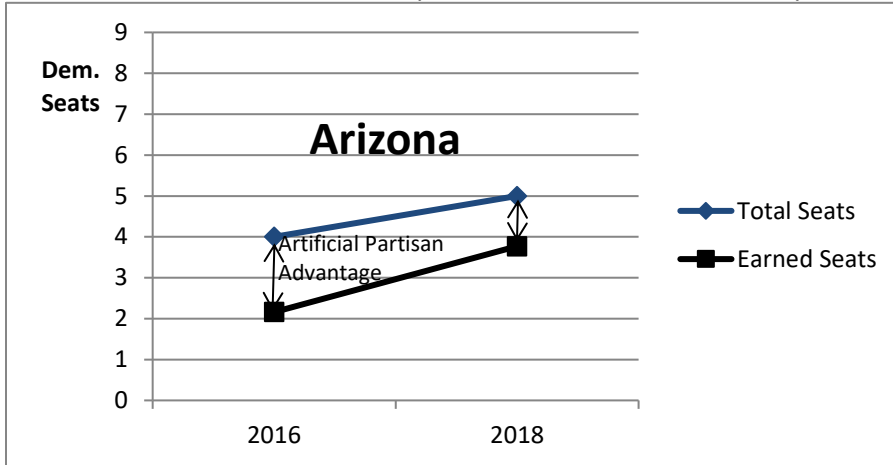
4.6. Georgia: a GOP partisan gerrymander.

In Georgia, the state legislature draws the redistricting map. The state delegation has 14 seats. The legislature has been under Republican control since 2011. The state legislature maps have been challenged in Court, but the congressional maps have not. Maybe they should have been.

In 2016, the Republican Party obtained 60.2% of the vote, winning in counties with 60.7% of the population, thus earning a benchmark of 8.50 seats. It obtained 10 seats in the election. In 2018, the Republican Party obtained 52.3% of the vote, but it lost all the most populous counties, including Gwinnett (with population over 800,000), the one it had won in 2016, so it only won counties with 46.6% of the state's population, earning 6.52 seats. It nevertheless kept a majority of 9-5 seats.

Averaging across both elections, the artificial partisan advantage is 1.99 seats, which discounting the rounding margin, is 1.49 seats, slightly above the 10% threshold.
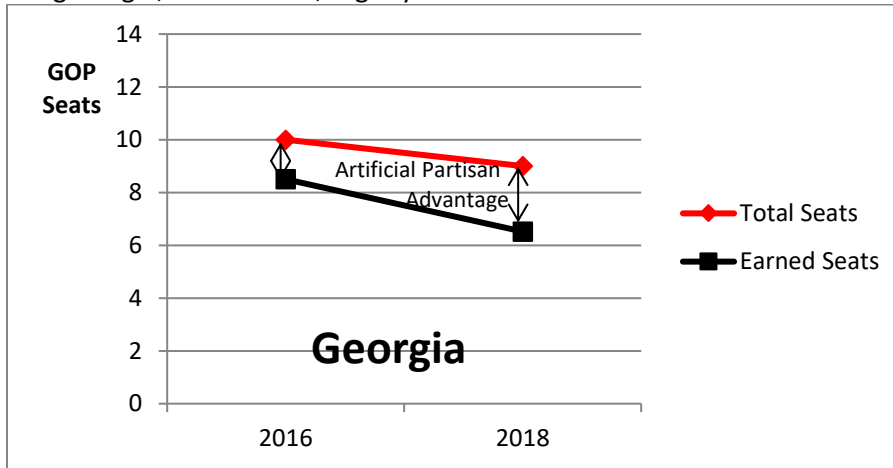
## 4.7. Maryland: a Democratic Party gerrymander.

In Maryland, the state legislature draws the redistricting map. The state delegation has 8 seats. The legislature has been under Democratic control since 2011.

In 2013, a group of voters challenged the Democratic-drawn maps in Court as a partisan gerrymander, leading to the series of *Benisek v Lamone* cases.[20] A district judge dismissed the case in 2014 and the US Courts of Appeals affirmed this decision; but in 2015 SCOTUS vacated these lower court decisions and remanded the case a district court, requiring that it be addressed by a panel. In 2018, a District Court panel ordered that new maps be drawn, and as of February 2019, the case is back at SCOTUS upon appeal, with oral arguments set for March 26th.

The evidence on the artificial partisan advantage is strongly against the 2011 maps:

In 2016, the Democratic Party obtained 63.0% of the two-party vote, and won in counties with 64.0% of the population, earning a benchmark of 5.12 seats (out of 8). In 2018 the Party obtained 66.9% and it won in counties with 78.4% of the population, hence earning a benchmark of 6.27 seats. With the gerrymandered maps, in both elections the Democratic Party obtained a majority of 7-1 seats.

Averaging across both elections, the artificial partisan advantage for the Democratic Party was 1.31 seats. Discounting the rounding margin, the advantage is 0.81, just above the threshold of 10% of the state's delegation. In short, the state delegation should have 5 Democrats in a bad year for them like 2016, and 6 in a good one like 2018; instead it has 7 in either case. While the artificial advantage is only barely above the cutoff, the district boundaries also seem indefensible on other grounds such as compactness or respect for political boundaries.
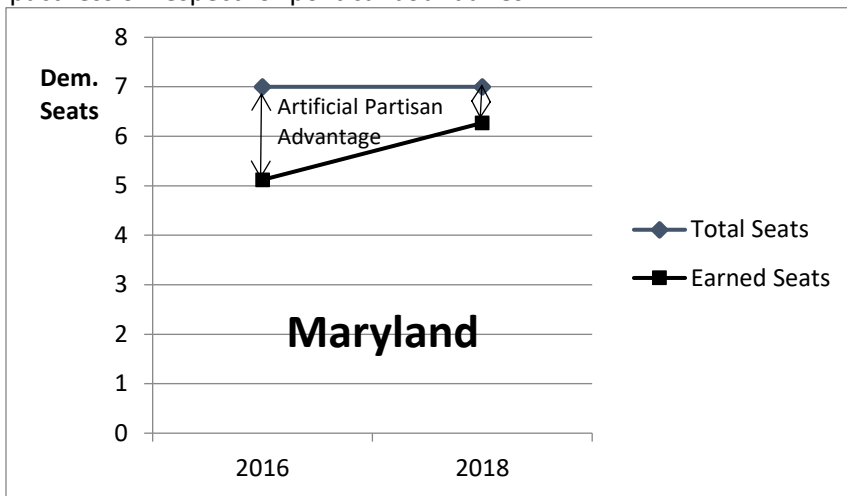
These seven states are the only ones with redistricting maps that violate the 10% rule on artificial partisan advantage. Together, the five states gerrymandered in favor of the GOP (NC, NE, UT, OH, and GA) account for an artificial partisan advantage of 10 seats to the GOP, and the two gerrymandered in favor of the Democratic Party (AZ, MD) yield 3 seats to the Democrats. Hence these seven states are collectively responsible for seven seats of Republican artificial partisan advantage, approximately half of the total advantage across 43 states with a delegation of at least two seats.

4.8. Florida: a Court map favored the Democratic Party.

In Florida, the state's legislature draws districts. The delegation has 27 seats. Since 2015, the legislature has been under Republican control. Its 2011 congressional maps were struck down by a racial and partisan gerrymander by a lower court in Florida, and the remedial maps generated by the legislature were struck down as well in 2015 by the Florida Supreme Court (*League of Women Voters* v

---

[20] See the documents of the litigation in these cases on the Brennan Center's website at
http://www.brennancenter.org/legal-work/benisek-v-lamone-amicus-brief.

Detzner No. SC14–1905). The Florida Supreme Court approved instead a map drawn by a coalition led by the League of Women Voters and Common Cause of Florida.[21]

This new map was used in the 2016 and 2018 elections generated an average artificial partisan advantage to the Democratic Party of 2.67 seats, which subtracting the 0.5 rounding margin, leaves 2.17 seats, well below the threshold of 10% of the state's delegation. Specifically, in 2016 the Democratic Party obtained 45.7% of the vote and won in counties with 33.6% of the population, earning a benchmark of 9.07 seats, but it obtained 11 seats; and in 2018 it obtained 47.4% of the vote and won in counties with 35.6% of the population, earning 9.6 seats according to our benchmark, but it won 13 seats.

4.9. Michigan: a GOP map favored the GOP.

In Michigan, the state legislature drew the districts for the 2012-2020 election cycle, but an independent citizens' commission will draw them for the 2022-2030 cycle.[22] The state had a delegation of 14 seats. Its maps have been challenged by the League of Women Voters; as of February 2019, the trial is currently in progress.

In 2016, the GOP obtained 50.6% of the vote and it won in counties representing 55% of the state's population, hence earning a benchmark of 7.7 seats. It won 9 districts. In 2018, the GOP obtained 46% of the vote and won counties representing 40.9% of the population, earning 5.72 seats. It won 7 on Election Day. Thus, the artificial partisan advantage was constant at 1.3 seats across both elections. Discounting the rounding margin, it leaves it at 0.8 seats, which is 5.7% of the State's delegation.[23]

4.10. Pennsylvania: a GOP map favored the GOP in 2016; a Court redrawn one in 2018 far less so.

In Pennsylvania, the state legislature draws redistricting maps. The delegation contains 18 seats. In 2011, the legislature was under Republican control.

The 2011 maps were struck down in 2018 by the Pennsylvania Supreme Court in *League of Women Voters of Pennsylvania* v *Commonwealth of Pennsylvania,* and shortly thereafter, the Court adopted its own remedial map, drawn under the advice of specially appointed master Stanford Law Professor Persily. Hence the Republican legislature's 2011 maps were used in the 2016 election, and Court maps in the 2018 election.

In 2016, the Republican Party won 54.1% of the two-party vote and it won counties with 64.3% of the population, earning a benchmark of 11.63 seats. It obtained 13 seats, for an artificial partisan advantage of 1.37 seats, which discounting the rounding margin, reduces to 0.87 seats, or 5% of the state's delegation size, a moderate artificial partisan advantage for the GOP, but below the threshold (the party gained an extra seat, instead of three as in the smaller states of Ohio and North Carolina).

The 2018 Court map almost entirely eliminated this advantage: the Republican Party won 44.9% of the vote, and it won counties with 46.8% of the population, earning a benchmark of 8.43 seats. The party won nine districts, for an artificial partisan advantage of 0.57 seats, which discounting the rounding margin, is only 0.07 seats. The Court's maps are almost neutral.

---

[21] Mary Ellen Klas. "Florida Supreme Court approves congressional map drawn by challengers." *Miami Herald,* Dec 2, 2015.

[22] The author (Jon X. Eguia) volunteered for *Voters Not Politicians*, the group that led the successful ballot initiative for this change.

[23] After Republican legislators pushed to draw maps that would generate a 10-4 GOP majority in most elections, consultant Bob LaBrant insisted they draw a more cautious 9-5 map instead: "*We needed for legal and PR purposes a good looking map that did not look like an obvious gerrymander,*" LaBrant wrote (Michael Wines, "New Emails Show Michigan Republicans Plotting to Gerrymander Maps", *New York Times,* July 25th, 2018). LaBrant's advice appears prescient in light of the rule I suggest: if the artificial partisan advantage had been a seat larger, it would have been above the threshold.

4.11. Texas: a GOP map slightly favored the GOP.

In Texas, congressional districts are drawn by the state legislature. The delegation has 36 seats. The state legislature has been under Republican control since 2011.

The 2011 maps were challenged in court and found to be a racial gerrymander. Remedial maps drawn in 2013 were challenged again, but in *Abbot* v *Perez,* 17-586-__ (2018), SCOTUS dismissed the claims against these remedial maps. The remedial maps favor the GOP, but not much.

As in Arizona, a huge county should be split up into two to obtain meaningful results. Harris County, including Houston, is the size of six congressional districts. The county is competitive: Democrats win Houston, and the GOP wins the rest of the county, and in 2016 the GOP won the county as a whole by less than 900 votes, out of a population of over four million). Assigning all six districts to the winner of Harris would be misleading: any redistricting map is likely to assign some districts in Houston to the Democrats, and some outside Houston to the Republicans. We thus split Harris into Houston, and non-Houston.[24]

In 2016, the Republican Party obtained 59.3% of the two-party vote in Texas, and it won in counties with 69.5% of the population (after excluding Houston as if it were a separate county in with the Democrats won), earning 25 seats, and 25 seats is exactly as many as it won in the election.

In 2018, the Republican Party obtained 51.8% of the vote, and it won in counties with 55.1% of the population, after including "Non-Houston Harris" as if it were its own county (this time the Republican Party lost Harris as a whole), earning 19.8 seats. It obtained 23 in the election.

Aggregating over both elections, the artificial partisan advantage is 1.58 seats, which after discounting the rounding margin, reduces to 1.08 seats, or little over 3% of the state's delegation.

4.12. Virginia: a Court map slightly favored the GOP.

In Virginia, the state legislature draws redistricting maps. The state's delegation has 11 seats. Virginia's General Assembly was under divided control in 2011, and was unable to agree on redistricting maps on that year. Once the GOP gained unified control of the state House and Senate, it approved redistricting maps in 2012. In 2015, these maps were struck down as a racial gerrymander by a district court (*Page* v *Virginia State Board of Elections* 3:13-cv-00678). Since the legislature was unable to draw new maps, the Court adopted instead a map drawn by a panel of federal judges. This Court-drawn map was in use in the 2016 and 2018 election.

In 2016, the Republican Party obtained 49.8% of the two-party vote, and won in counties with 50% of the population, earning a benchmark of 5.5 seats. It won 7 districts. In 2018, it obtained 43% of the vote, and it won in counties with 34.9% of the population, earning a benchmark of 3.84 seats. It won 4 districts. Averaging over the two elections, the artificial partisan advantage is 0.83, or 0.33 without the rounding margin, which is only 3% of the size of the state's delegation.

4.13. Wisconsin: a GOP map slightly favored the GOP.

In Wisconsin, redistricting maps are drawn by the legislature. The state's delegation has 8 seats. In 2011, the legislature was under unified Republican control for part of the year, and under divided control for a few months. The legislature approved the 2011 redistricting maps during the time of unified Republican control. These maps were challenged.

In 2016, a 3-judge panel district court ruled these maps an illegal partisan gerrymander (*Whitford v. Gill* 218 F. Supp. 3d 83.). In *Gill v. Whitford*, 585 U.S. ___ (2018), SCOTUS remanded the case back to the lower courts on technical grounds. Trial is now set for summer 2019.

---

[24] The Census definition of Houston is narrower than the USPS's one. Houston also has limited jurisdiction over some territory. Hence there is no single definition of "Houston." We consider a Harris county electoral precinct to be in Houston if Proposal 2018 A regarding the City of Houston was on the ballot in this precinct.

The Wisconsin redistricting case is one in which the natural GOP advantage due to population sorting is most stark. In 2016, the Republican Party only obtained 47.9% of the two-party vote, but it won a 5-3 majority of the congressional delegation with this minority vote. In 2018, its minority share of the vote decreased to only 46.2%, but again it kept a 5-3 majority in seats, despite the 8 point loss in votes. Republicans argue that these counter-intuitive outcomes are due to sorting of Democrats into cities, were they win by landslides, while Republicans have smaller majorities everywhere else. Democrats argue that partisan gerrymander, and not sorting, explains why a minority of voters obtain a majority of seats.

The measure of artificial partisan advantage partially backs the Republican arguments: in 2016 they won in counties with 56.1% of the population, earning 4.49 seats according to county lines; and in 2018 they won in counties with 50.7% of the population, earning 4.06 seats. The artificial partisan advantage averaged over the two election years is only 0.72 seats, or 0.22 after discounting the rounding margin, which is only 2.8% of the state's delegation.

According to the artificial partisan advantage measure, the redistricting maps accounted for one seat in 2018, but sorting alone can explain why a minority of Republican voters obtain a majority of congressional seats in Wisconsin in an election like 2016's.

4.14. California: a Citizens' Commission map slightly favored the GOP.
In California, redistricting maps are drawn by an independent citizens' commission. The state delegation has 53 seats.

In 2016, the Republican Party obtained 36% of the two-party vote, and it won in counties with 21% of the population, thus deserving 11.1 seats according to county lines. The party won 14 seats.

In 2018, the Republican Party obtained 33.1% of the two-party vote, and it won in counties with 15.3% of the population, thus earning 7.04 seats. It indeed won exactly 7 seats.

The artificial partisan advantage averages to 1.47 seats, or 0.97 seats without the rounding margin, which is less than 2% of the state's delegation. The commission's maps, unlike its brethren's in Arizona, are nearly neutral.

4.15. New York: a bipartisan map slightly favored the GOP.
In New York, redistricting maps are drawn by the state's legislature. The size of the state delegation is 27 seats. In 2011, the legislature was under divided control, so the maps drawn were the result of a bipartisan effort.

In 2016, the Republican Party obtained 36.2% of the two-party vote, and it won in counties with 26.8% of the population, earning 7.71 seats. It won 9 seats in the election. In 2018, it won 32.3% of the vote, and it won in counties with 19.4% of the population, earning 5.24 seats. It won 6 seats in the election. The average artificial partisan advantage for the Republican Party is thus 1.03 seats, or only 0.53 after we discount the rounding margin. This is less than 2% of the size of the delegation, so a close to neutral map.

4.16. Summary of other states
Among the remaining 28 states that must draw congressional districts, none have drawn maps that violate the threshold of an artificial partisan advantage above 10% of the state's delegation. Only 3 range between 5% and 10%: New Hampshire (favoring Democrats), and Alabama and Indiana (favoring Republicans). A further three exhibit a small artificial partisan advantage of less than 5%: Washington (for the Democrats), and Arkansas and Missouri (for the Republicans). The other twenty two states use maps that are neutral.

The correlation in the results between the 2016 and 2018 election is strong: the coefficient of correlation in the subsample of 42 states that used the same map in 2016 and 2018 (all but

Pennsylvania) is +0.58. Every state with an artificial partisan advantage above the 10% threshold in a given year shows an artificial partisan advantage for the same party in the other election year.

A remarkable property that hints at the partisan nature of redistricting at the hands of legislatures is that every redistricting map drawn by a legislature under Republican control either favors Republicans or is neutral, while similarly every map drawn by a legislature under Democratic control either favors Democrats, or is neutral. Whereas, among the two states redistricted by citizens' commissions, one favors the Democratic Party (Arizona, strongly so), and one favors the Republican Party (California, weakly so), and similarly among Court-mandated maps, one favors the Democratic Party (Florida), one favors the Republican Party (Virginia), and one is almost neutral (Pennsylvania). In short, commissions and Courts may err, but on the aggregate they appear unbiased –or at least unpredictable in their biases- while partisan legislatures never err on the side of aiding the opposition.

5. DISCUSSION

The artificial partisan advantage is a measure of partisan advantage in redistricting that is based on comparing the number of seats a party gets, with the number of seats it would get using natural maps. Consistent with previous Supreme Court precedents, the natural maps used as a benchmark are those that follow county lines. The artificial partisan advantage is the difference between the number of seats won, and the number that would accrue to the party if seats were assigned to counties in proportion to population. This measure is consistent with Supreme Court requirements that the measure not rely on counterfactual votes, and that it be a standard that is easy and manageable to apply.

Unlike other measures, it can be computed for states of any size, and it distinguishes between the natural partisan advantage that is due to population sorting, and the artificial partisan advantage that is due to the way the redistricting maps are drawn. It is only the latter that counts toward presuming that a map is an illegal partisan gerrymander.

In elections to the US House of Representatives, redistricting applies to the 43 states with at least 2 representatives. Across these states, the estimated aggregate artificial partisan advantage is fifteen seats, both in 2016 and in 2018. This estimate is smaller than other estimates that use the efficiency gap measure, or vote-to-seat curves. For instance, Royden and Li (2017) estimate a Republican partisan advantage of 16 to 29 seats in the 2016, restricted to the subsample of 26 states with at least 6 seats.[25] They explain that:

> *"Some of this bias is likely the result of political geography and other pertinent structural factors ¬which the efficiency gap cannot differentiate from intentional gerrymandering − but the existence of large levels of bias in states where Republicans had sole control of the redistricting processes strongly suggests that a sizeable portion of the pro-Republican bias likely stems from deliberate manipulation of maps."*

The measure of artificial partisan advantage can quantify the portion of Republican bias that stems the maps: 15 seats. This portion cannot be explained away by population sorting.

To determine whether a redistricting map is a partisan gerrymander, I propose a 10% rule: if the artificial partisan advantage, after discounting a rounding margin of 0.5 seats, is superior to 10% of the size of the state's delegation, then the map is presumed to be a partisan gerrymander. Choosing 10% as the operational threshold is also in keeping with the Supreme Court's previous choice of threshold.

---

[25] The efficiency gap and vote-seat curve are not well suited to study small states.

Seven states violate this 10% rule: North Carolina, Nebraska, Utah and Georgia for the Republican Party, and Arizona and Maryland for the Democratic Party. Notably, the most egregious partisan gerrymander drawn by a Republican legislature (North Carolina), and the most egregious one drawn by a Democratic legislature (Maryland), are both before the Supreme Court as of February 2019, with hearings scheduled for March 2019. The evidence on the artificial partisan advantage suggests that both of these maps should be struck down as unconstitutional partisan gerrymanders.

The artificial partisan advantage is a manageable standard that can help the US Supreme Court to identify unconstitutional partisan gerrymanders. In addition to the current and future federal cases, several states -including California, Florida, Michigan or Arizona- mandate in their state's constitution that redistricting maps provide no partisan advantage to any party. In each of these states, the states' courts can use the artificial partisan advantage to identify redistricting maps for state legislatures that violate this constitutional requirement.[26] States with an explicit constitutional mandate against partisan advantage in redistricting may well require a more demanding rule, and a lower threshold of tolerance, than 10% of the size of the delegation.

For instance, as of February 2019, a trial is underway in a district court over Michigan maps. The Michigan Constitution states that: "*Districts shall not provide a disproportionate advantage to any political party. A disproportionate advantage to a political party shall be determined using accepted measures of partisan fairness*" (Art. IV, Section 6, subsection 13.d). The Michigan Senate has 38 seats, in 2018 the GOP won in counties with 51.8% of the population, which corresponds to 19.68 seats, but it won 22, so the artificial partisan advantage for the GOP was 2.32 seats. This is a case in which it is essential to distinguish a natural partisan advantage due to population sorting, from the artificial partisan advantage due to the drawing of the maps. The Republican party obtained only 48.7% of the two-party vote, suggesting that it should attain fewer than half the seats. But due to the natural advantage based on sorting, the GOP would obtain 19.68 seats if seats were assigned by population-weighted county lines. It is only the excess from 19.68 to 22 seats, that can be attributed to redistricting. Discounting the rounding margin of 0.5, the artificial partisan advantage is 4.7% of the size of the Senate. Thus, if Michigan Courts apply a 5% threshold to declare the advantage "disproportionate", then the maps would be on the cusp, but not beyond, this threshold.

The immediate purpose of the artificial partisan advantage is to serve as a tool to identify which redistricting maps are a partisan gerrymander, so that legislators and commissions avoid drawing such maps, and Courts strike them down more confidently if drawn, to be substituted by more neutral maps without such partisan advantage. The ultimate goal is to contribute to help run elections with more equal protection, voice and opportunity to all citizens, and with a fairer representation of the citizenry's preferences in our elected bodies.

---

[26] To this end, we are currently working on providing measures of the artificial partisan advantage in maps for states' legislatures for the 2016 and 2018 elections.

APPENDIX

TABLE 1: ARTIFICIAL PARTISAN ADVANTAGE IN NEW HAMPSHIRE, 2018.

County Name	[1] Pop	[2] D Vote	[3] R Vote	Pop. counties won by [4] Dem	[5] Rep
Belknap	60,088	12,256	14,125	0	60,088
Carroll	47,818	12,146	11,464	47,818	0
Cheshire	77,117	19,784	11,830	77,117	0
Coos	33,055	6,008	4,971	33,055	0
Grafton	89,118	25,627	13,499	89,118	0
Hillsborough	400,721	87,489	71,360	400,721	0
Merrimack	146,445	36,702	26,626	146,445	0
Rockingham	295,223	71,211	66,089	295,223	0
Strafford	123,143	30,819	21,469	123,143	0
Sullivan	43,742	9,200	7,553	43,742	0
N. HAMPSHIRE	**1,316,470**	**311,242**	**248,986**	**1,256,382**	**60,088**
				95.44%	4.56%
			Natural seats	1.91	0.09
			Total Seats	2.00	0.00
		Artificial Partisan Advantage		0.09	-0.09

Table 3 demonstrates the procedure to compute the artificial partisan advantage in each state. I select New Hampshire as an example because it is a state with few counties. New Hampshire has 2 seats in the House of Congress, and hence two electoral districts. For each county, column [1] indicates the population of the county; column [2] the vote for the Democratic Party candidate, if the county belongs to a single congressional district, or the sum of the votes for the Democratic party candidates in each district, in counties that overlap both districts; column [3] is the analogous sum of votes for Republican candidates. In counties in which the Democratic party candidates got more votes ([2]>[3]), the population of the county is assigned to the Democratic column [4], whereas in counties in which the Republican party candidates got more votes ([3]>[2]), the county population goes to the Republican column [5]. Adding up across counties, we get the state totals. We find that 95.4% of the population lives in counties won by the Democratic candidates, and 4.6% in counties won by the Republicans. So we compute that according to county lines, the Democratic Party natural seat benchmark is 95.4% of 2 seats, that is, 1.91 seats. The Republican Party's is 0.09 seats. Since the Democratic Party gets both seats in New Hampshire, the artificial partisan advantage is 2.00 – 1.91 = 0.09, which is within the rounding margin of 0.5, so this map is presumed to not be a partisan gerrymander.

TABLE 2: ARTIFICIAL PARTISAN ADVANTAGE BY STATE, 2016 US HOUSE ELECTION

| State | [1] Seats | [2] R vote | Pop. in counties won | | Republican Seats | | |
			[3] by R	[4] by D	[5] Earned	[6] Total	[7] Art. Adv.
Alabama	7	66.3%	3,406,840	1,372,896	4.99	6	1.01
Arizona[+]	9	54.1%	4,855,195	1,536,822	6.84	5	-1.84
Arkansas	4	87.2%	2,533,170	382,748	3.47	4	0.53
California	53	36.3%	7,805,597	29,448,359	11.10	14	2.90
Colorado	7	50.5%	2,547,634	2,481,562	3.55	4	0.45
Connecticut	5	36.5%	0	3,574,097	0.00	0	0.00
Florida	27	54.3%	12,486,046	6,315,264	17.93	16	-1.93
Georgia	14	60.3%	5,881,049	3,806,604	8.50	10	1.50
Hawaii	2	21.3%	0	1,360,211	0.00	0	0.00
Idaho	2	68.2%	1,546,206	21,376	1.97	2	0.03
Illinois	18	46.0%	6,214,575	6,616,057	8.72	7	-1.72
Indiana	9	57.8%	4,403,689	2,080,113	6.11	7	0.89
Iowa	4	54.7%	1,648,736	1,397,619	2.16	3	0.84
Kansas	4	68.6%	2,575,254	268,331	3.61	4	0.39
Kentucky	6	70.7%	3,598,271	741,096	4.97	5	0.02
Louisiana[*]	6	71.0%	3,783,583	464,635	5.01	5	0.01
Maine	2	48.0%	685,652	642,709	1.03	1	-0.03
Maryland	8	37.0%	2,078,729	3,694,823	2.88	1	-1.88
Massachusetts	9	16.1%	0	6,547,629	0.00	0	0.00
Michigan	14	50.6%	5,434,201	4,449,439	7.70	9	1.30
Minnesota	8	48.2%	2,063,674	3,240,251	3.11	3	-0.11
Mississippi	4	60.2%	2,165,059	802,238	2.92	3	0.08
Missouri	8	60.6%	3,996,521	1,992,406	5.34	6	0.66
Nebraska	3	71.6%	1,309,231	517,110	2.15	3	0.85
Nevada	4	49.5%	749,282	1,951,269	1.11	1	-0.11
N. Hampshire	2	48.4%	803,850	512,620	1.22	0	-1.22
New Jersey	12	45.8%	3,417,346	5,374,548	4.66	5	0.34
New Mexico	3	44.0%	684,619	1,374,560	1.00	1	0.00
New York	27	36.2%	5,535,110	13,842,992	7.71	9	1.29
North Carolina	13	53.3%	5,121,073	4,414,410	6.98	10	3.02
Ohio	16	58.2%	7,217,045	4,319,459	10.01	12	1.99
Oklahoma	5	71.9%	3,751,351	0	5.00	5	0.00
Oregon	5	41.6%	1,204,332	2,626,742	1.57	1	-0.57
Pennsylvania	18	54.1%	8,209,893	4,492,486	11.63	13	1.37
Rhode Island	2	34.9%	0	1,052,567	0.00	0	0.00
South Carolina	7	59.5%	3,739,998	885,366	5.66	6	0.34
Tennessee	9	64.7%	4,772,993	1,573,112	6.76	7	0.23
Texas[+]	36	59.3%	17,471,686	7,673,875	25.01	25	-0.16
Utah	4	66.6%	1,697,906	1,065,979	2.45	4	1.54
Virginia	11	49.8%	3,995,691	3,999,111	5.50	7	1.50
Washington[*]	10	45.4%	2,056,083	4,590,294	3.06	4	0.94
West Virginia	3	66.4%	1,633,650	219,344	2.64	3	0.36
Wisconsin	8	47.9%	3,191,830	2,495,156	4.49	5	0.51
TOTAL	428		156,272,650	146,218,285	220.52	236	15.48

[*] Candidacies outside the two main parties won St Martin (LA) and Franklin (WA) counties.

[+] I treat Maricopa (AZ) as two counties: Phoenix and Rest; and Harris (TX) as Houston and Rest.

TABLE 3: ARTIFICIAL PARTISAN ADVANTAGE BY STATE, 2018 US HOUSE ELECTION

State	[1] Seats	[2] R vote	Pop. in counties won		Republican Seats		
			[3] by R	[4] by D	[5] Earned	[6] Total	[7] Art. Adv.
Alabama	7	59.0%	3,402,297	1,377,439	4.98	6	1.02
Arizona[+]	9	49.2%	3,712,763	2,679,254	5.23	4	-1.23
Arkansas	4	64.0%	2,332,594	583,324	3.20	4	0.80
California	53	33.1%	4,952,633	32,301,323	7.05	7	-0.05
Colorado	7	44.6%	1,981,523	3,047,673	2.76	3	0.24
Connecticut	5	38.0%	189,927	3,384,170	0.27	0	-0.27
Florida	27	52.6%	12,117,447	6,683,863	17.40	14	-3.40
Georgia	14	52.3%	4,510,631	5,177,022	6.52	9	2.48
Hawaii	2	23.3%	0	1,360,211	0.00	0	0.00
Idaho	2	63.9%	1,498,792	68,790	1.91	2	0.09
Illinois	18	38.9%	2,798,967	10,031,665	3.93	5	1.07
Indiana	9	55.5%	4,286,018	2,197,784	5.95	7	1.05
Iowa	4	47.9%	1,307,082	1,739,273	1.72	1	-0.72
Kansas	4	55.1%	1,791,559	1,061,559	2.51	3	0.49
Kentucky	6	60.4%	3,253,183	1,086,184	4.50	5	0.50
Louisiana	6	62.9%	4,035,350	498,022	5.34	5	-0.34
Maine	2	42.4%	386,245	942,116	0.58	0	-0.58
Maryland	8	33.0%	1,249,709	4,523,843	1.73	1	-0.73
Massachusetts	9	20.4%	0	6,547,629	0.00	0	0.00
Michigan	14	46.0%	4,041,237	5,842,403	5.72	7	1.28
Minnesota	8	44.2%	3,328,766	1,975,159	2.98	3	0.02
Mississippi	4	54.2%	2,070,236	886,464	2.79	3	0.21
Missouri	8	56.4%	3,833,879	2,155,048	5.12	6	0.88
Nebraska	3	62.3%	1,023,824	802,517	1.68	3	1.32
Nevada	4	47.2%	749,282	1,951,269	1.11	1	-0.11
N. Hampshire	2	44.4%	60,088	1,256,382	0.09	0	-0.09
New Jersey	12	39.2%	1,659,336	7,132,558	2.26	1	-1.26
New Mexico	3	39.6%	515,164	1,544,015	0.75	0	-0.75
New York	27	32.3%	3,757,373	15,620,729	5.24	6	0.76
North Carolina	13	51.0%	4,871,767	4,663,716	6.64	10	3.36
Ohio	16	52.4%	6,253,252	5,283,252	8.67	12	3.33
Oklahoma	5	63.0%	3,032,718	718,633	4.04	4	-0.04
Oregon	5	39.8%	925,060	2,906,014	1.21	1	-0.21
Pennsylvania	18	44.9%	5,949,677	6,752,702	8.43	9	0.57
Rhode Island	2	34.9%	0	1,052,567	0.00	0	0
South Carolina	7	55.0%	3,428,681	1,196,683	5.19	5	-0.19
Tennessee	9	60.2%	4,772,993	1,573,112	6.77	7	0.23
Texas[+]	36	51.8%	13,849,850	11,295,711	19.83	23	3.33
Utah	4	62.3%	1,688,681	1,075,204	2.44	3	0.56
Virginia	11	43.0%	2,787,476	5,207,326	3.84	4	0.16
Washington	10	36.7%	1,664,107	5,060,433	2.47	3	0.53
West Virginia	3	59.0%	1,493,074	359,920	2.42	3	0.58
Wisconsin	8	46.1%	2,882,782	2,804,204	4.06	5	0.79
TOTAL	428		128,446,023	174,407,165	179.33	195	15.68

[+] I treat Maricopa (AZ) as two counties: Phoenix and Rest; and Harris (TX) likewise as Houston and Rest.

REFERENCES

-Brookes, R. H. 1959. "Electoral distortion in New Zealand". *Australian Journal of Politics and History* 5: 218–223.

-Brookes, R. H. 1960. "The analysis of distorted representation in two-party single member systems." *Political Science* 12: 158–167.

-Chambers, Christopher P. and Alan D. Miller. 2010. "A measure of bizarreness." *Quarterly Journal of Political Science* 5(1): 27-44.

-Chambers, Christopher P., Alan D. Miller, and Joel Sobel. 2017. "Flaws in the efficiency gap." *Journal of Law & Politics* 33(1): 12-23.

-Chen, Jowei and David Cottrell, 2014. "Evaluating Partisan Gains from Congressional Gerrymandering: Using Computer Simulations to Estimate the Effect of Gerrymandering in the U.S. House." Working paper.

-Grofman, Bernard. 1983. "Measures of bias and proportionality in seats–votes relationships." *Political Methodology* 9: 295–327.

-King, Gary, and Robert X. Browning. 1987. "Democratic representation and partisan bias in Congressional elections." *American Political Science Review* 81: 1251–1273.

-McDonald, Michael D. and Robin E. Best. 2015. "Unfair partisan gerrymanders in politics and Law: a diagnostic applied to six cases." *Election Law Journal* 14(4): 312--330.

-Royden, Laura, and Michael Li. "Extreme Maps." Brennan Center for Justice.

-Stephanopoulos, Nicholas O., and Eric M. McGhee. 2015. "Partisan Gerrymandering and the Efficiency Gap." *University of Chicago Law Review* 82: 831--900.

-Stephanopoulos, Nicholas O., and Eric M. McGhee. 2018. "The measure of a metric: The debate over quantifying partisan gerrymandering." *Stanford Law Review* 70: 1503--1568.

-Tufte, E. R. 1973. "The relationship between seats and votes in two-party systems." *American Political Science Review* 67: 540–554.

-Wang, Samuel S-H. 2016. "Three tests for practical evaluation of partisan gerrymandering." *Stanford Law Review* 68: 1263-1321.